Test Date: 05/08/2020

B
CODE

Aakash

Medical | IIT-JEE | Foundations

(Divisions of Aakash Educational Services Limited)

***Regd. Office*:** Aakash Tower, 8, Pusa Road, New Delhi-110005, Ph.011-47623456

Time: 3 hrs **MM : 180**

Mock Test
for JEE (Advanced) - 2020
Test – 4A (Paper – II)_Actual Pattern-2018

Topics covered:

PHYSICS : MOCK TEST on Complete Syllabus

CHEMISTRY : MOCK TEST on Complete Syllabus

MATHEMATICS : MOCK TEST on Complete Syllabus

General Instructions:

1. Read each question carefully.
2. It is mandatory to use blue/black ballpoint pen to darken the appropriate circle in the answer sheet.
3. Mark should be dark and should completely fill the circle.
4. Rough work must not be done on the answer sheet.
5. Do not use white-fluid or any other rubbing material on answer sheet.
6. Student cannot use log table and calculator or any other material in the examination hall.
7. Before attempting the question paper, student should ensure that the test paper contains all pages and no page is missing.
8. Before handing over the answer sheet to the invigilator, candidate should check that Roll No., Centre Code and Date of Birth have been filled and marked correctly.
9. Immediately after the prescribed examination time is over, the answer sheet is to be returned to the invigilator.
10. **Pattern of the questions are as under :**

    (i) The question paper consists of 3 parts (Physics, Chemistry and Mathematics). Each part has 3 sections.

    (ii) **Section-1:** This section contains **6** multiple choice questions which have one or more correct answer(s). Each question carries **+4 marks** for correct answer and **–2 marks** for wrong answer. Partial **+1 mark** is given for darkening a bubble corresponding to each correct option, provided NO incorrect option is darkened

    (iii) **Section-2:** This section contains **8** questions. The answer to each of the question is a **double-digit integer**, ranging from 00 to 99 (both inclusive) without being given any option. Each question carries **+3 marks** for correct answer and there is **no negative mark** for wrong answer.

    (iv) **Section-3:**This section contains **4** multiple choice questions. Each question has two matching lists : (**List-I** and **List-II**). In general, four options are given representing matching of elements from **List-I** and **List-II**. **Only ONE** of these four options corresponds to a correct matching. For each question, choose the option corresponding to the correct matching. Each question has **only one** answer is correct and carries **+3 marks** for correct answer and **–1 mark** for wrong answer

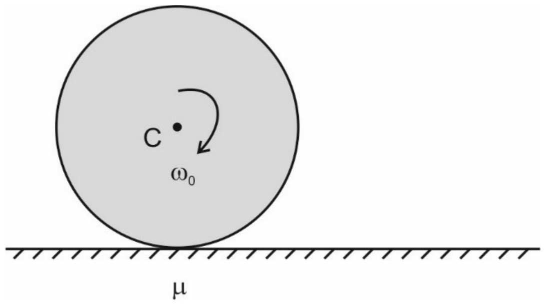
PART – I: PHYSICS

SECTION - 1

One or More than One Option Correct Type

This section contains **6** questions. Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct option(s).

1. A solid cylinder of radius R and mass m spinned at angular speed ω_0 is placed on a rough horizontal surface as shown. Then



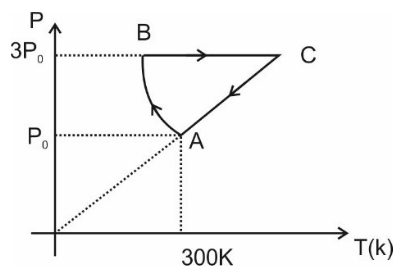
(A) Velocity of centre C when pure rolling starts is $\frac{\omega_0 R}{3}$

(B) Work done by frictional force is $-\frac{M\omega_0^2R^2}{6}$

(C) Work done by frictional force is $-\frac{M\omega_0^2R^2}{3}$

(D) Kinetic energy when pure rolling starts is $\frac{M\omega_0^2R^2}{12}$

2. One mole of a monoatomic gas taken through a cyclic process ABC as shown in PT diagram, in which process A $\rightarrow$B is defined as PT = constant. Then



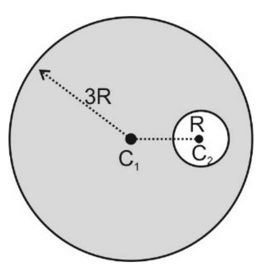
(A) Work done in process AB is –400R

(B) Heat supplied to gas in process BC is 2000R

(C) Change in internal energy in process CA is – 900R

(D) Work done in process BC is 800 R

3. There is a spherical cavity of radius R inside a neutral conducting sphere of radius 3R as shown. A point charge Q is placed at distance $\frac{R}{2}$ from centre of cavity, then



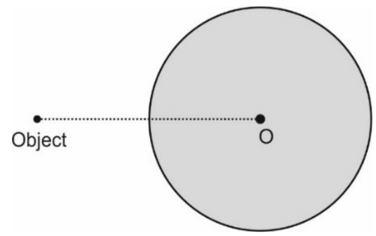
(A) Charge density on inner surface of cavity is non-uniform

(B) Charge density on outer surface of sphere is uniform

(C) Electric potential at centre C_1 is $\dfrac{Q}{12\pi \in_0 R}$

(D) Electric potential at centre of cavity C_2 is $\dfrac{Q}{3\pi \in_0 R}$

4. An object is placed at distance of 40 cm from centre of a glass sphere of radius 10 cm as shown. If $\mu_{glass} = 1.5$, then



(A) Final image is real
(B) Final image is virtual
(C) Final image is at distance 4 cm from O
(D) Final image is at distance 24 cm from O

5. The energy of a particle executing simple harmonic motion is given by $E = Ax^2 + Bv^2$, where x is displacement from mean position and v is velocity of particle at $x = x$, then

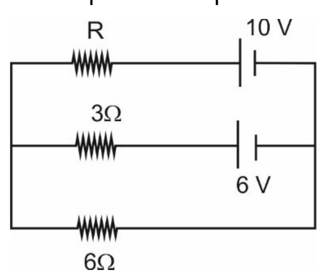
(A) Time period of oscillation is $2\pi\sqrt{\dfrac{B}{A}}$

(B) Amplitude of SHM is $\sqrt{\dfrac{E}{A}}$

(C) Maximum velocity is $\sqrt{\dfrac{E}{B}}$

(D) Total oscillation energy remains constant

6. In the circuit shown the cells are ideal. The power dissipation through resistance R is maximum, then

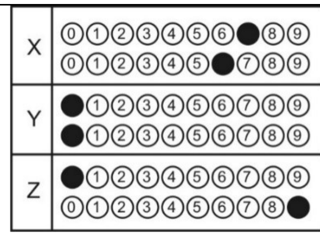


(A) Value of R is 2Ω
(B) Power dissipation through R is 4.5 W
(C) Current through cell of emf 10V is 1.5 A
(D) Power dissipation through resistance of resistance 6Ω is 16.3 W

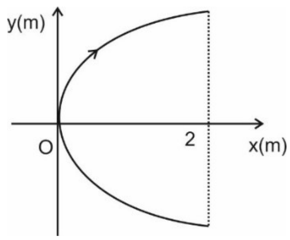
SECTION - 2

Integer Value Type

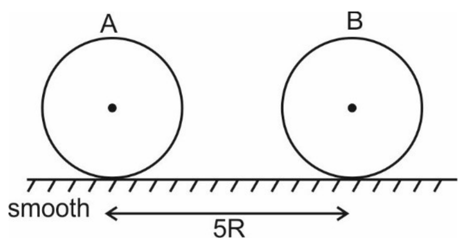
This section contains **8** questions. The answer to each of the question is a **Double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively



7. A conducting wire is bent in the form of a parabola $y^2 = 2x$ as shown in figure. It carries a current of 2A. A uniform magnetic field $\vec{B} = -4\hat{k}$ T exists in the region. Find the magnetic force on the wire (in newton)

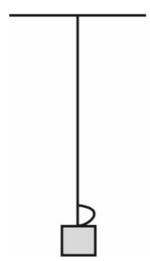


8. Two spherical shells A and B of mass m, 2m radius R each and charges Q, –Q respectively are released from separation 5R on a smooth surface as shown. If the speed of shell A just before collision is given as $V_A = \sqrt{\frac{Q^2}{P\pi \in_0 mR}}$, then find the value of P

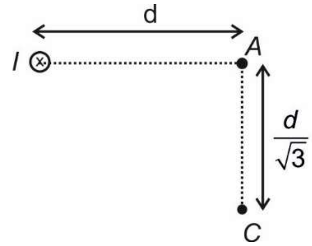


9. A radioactive sample X disintegrates into Y and Y disintegrates into Z. Half-life of X is 20 years and that of Y is 10 years. At t = 0, sample X starts decaying and there is not any nuclei of Y then find time (in years) when Y would have maximum nuclei.

10. A uniform metal wire of length 12 m and mass 6 kg hangs vertically with a rigid support. A block of mass 2 kg is attached at the lower end of wire as shown. A wave pulse of wavelength 6 cm is generated at the lower end of wire. Find the wavelength of pulse (in cm) when it reaches the top end of wire.

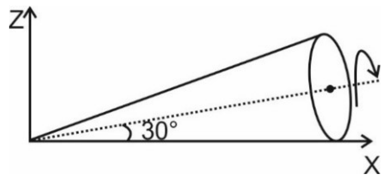


11. A long wire carrying current I is along perpendicular to plane shown in figure. The line integral $\int \vec{B}.\vec{dl}$ from point A to C is $\frac{\mu_0 I}{n}$. Find value of n. $\vec{B}$ is magnetic field

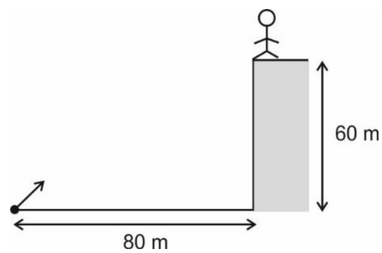


12. In a YDSE experiment, λ = 600 nm and maximum intensity on screen in I_m. P is a point on screen where 10^{th} maxima is formed. Now the set-up is immersed into water $\left(\mu = \frac{4}{3}\right)$ and intensity at same point P becomes $\frac{I_m}{n}$. Assume intensity due to each slit does not change. Find value of n.

13. A right circular cone of semi-vertex angle of 30° is rolling without slipping on horizontal surface with its vertex at origin as shown. If angular speed about axis of cone is 20 rad/s, then find angular speed of cone about z-axis in rad/s



14. A terrorist is standing on a tall building of height 60 m. A sniper wishes to shoot the terrorist from a point on ground at a distance 80 m from the building (see figure). With what minimum speed (in m/s), the bullet be fired in order to shoot the terrorist?

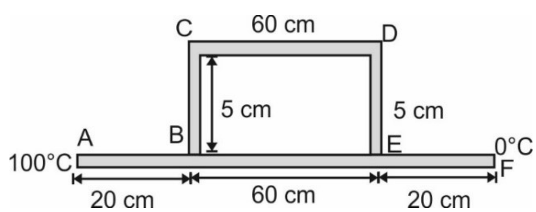


SECTION - 3

Matrix Match Type

This section contains Four **4** question. Each question has TWO (02) matching lists. LIST-I and LIST-II. Each question has Four options. **ONLY ONE** of these four options corresponds to the correct answer. For each question, choose the option corresponding to the correct answer.

15. The frame shown in the figure is made of same material and has same cross-section area everywhere. Input heat current is 130 J/s at end A. List I contains some parameter and List II contains corresponding values. Select the correct match



List-I	**List-II**
(P) Temperature at point B in °C	(1) 30
(Q) Temperature at point E is °C	(2) 70
(R) Heat current through section CD is J/s	(3) 27.7
(S) Heat current through section BE in J/s	(4) 60
	(5) 72.3

(A) P → 2, Q → 1, R → 5, S → 4
(B) P → 3, Q → 5, R → 4, S → 1
(C) P → 5, Q → 3, R → 4, S → 2
(D) P → 5, Q → 4, R → 3, S → 2

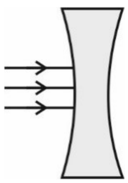
16. List contains type of electromagnetic radiations, of emission spectrum of hydrogen spectrum. List II contains the corresponding possible transitions, Select the correct match.

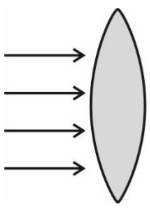
List-I	**List-II**
(P) Ultraviolet Light	(1) $n_1 = 6 \rightarrow n_2 = 3$
(Q) Visible light	(2) $n_1 = 3 \rightarrow n_2 = 1$
(R) Infrared radiation	(3) $n_1 = 4 \rightarrow n_2 = 2$
(S) Microwaves	(4) $n_1 = 7 \rightarrow n_2 = 6$
	(5) $n_1 = 2 \rightarrow n_2 = 1$

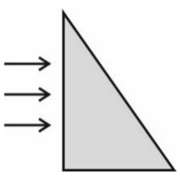
(A) $P \rightarrow 3$; $Q \rightarrow 3$; $R \rightarrow 4$; $S \rightarrow 1$
(B) $P \rightarrow 2, 5$; $Q \rightarrow 3$; $R \rightarrow 1$; $S \rightarrow 4$
(C) $P \rightarrow 2$; $Q \rightarrow 4$; $R \rightarrow 5$; $S \rightarrow 3$
(D) $P \rightarrow 5$; $Q \rightarrow 4$; $R \rightarrow 2$; $S \rightarrow 1$

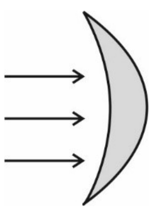
17. List I contains optical devices on which parallel beam of light is incident List II contains the shape of emergent wave form. Select the correct match

List-I

(P) 

(Q) 

(R) 

(S) 

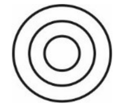
List-II

(1) 

(2) 

(3) 

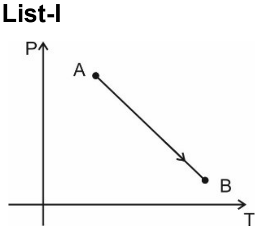
(4) 

(5) 

(A) $P \rightarrow 1$; $Q \rightarrow 5$; $R \rightarrow 3$; $S \rightarrow 2$
(B) $P \rightarrow 3$; $Q \rightarrow 1$; $R \rightarrow 2$; $S \rightarrow 4$
(C) $P \rightarrow 2$; $Q \rightarrow 3$; $R \rightarrow 1$; $S \rightarrow 4$
(D) $P \rightarrow 3$; $Q \rightarrow 1$; $R \rightarrow 2$; $S \rightarrow 1$

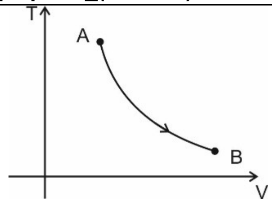
18. List I contains the process diagram of an ideal gas from $A \rightarrow B$. List II contains the related properties. Select the correct match.

List-I

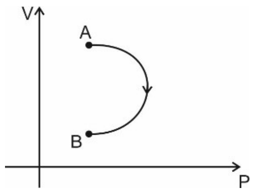
(P) 

List-II

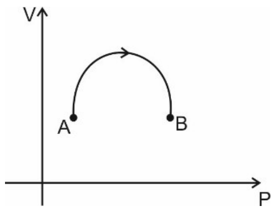
(1) Work done by gas is positive

(Q) 

(2) Work done by gas is negative

(R) 

(3) Specific heat must be positive

(S) 

(4) Change in internal energy is positive

(5) Change in internal energy is negative

(A) P $\rightarrow$ 1, 3, 4 ; Q $\rightarrow$ 1, 5 ; R $\rightarrow$ 2 ; S $\rightarrow$ 4

(B) P $\rightarrow$ 3 ; Q $\rightarrow$ 5 ; R $\rightarrow$ 2, 5 ; S $\rightarrow$ 4

(C) P $\rightarrow$ 1, 3, 4 ; Q $\rightarrow$ 1, 5 ; R $\rightarrow$ 2, 5 ; S $\rightarrow$ 2, 4

(C) P $\rightarrow$ 1 ; Q $\rightarrow$ 1, 4 ; R $\rightarrow$ 5 ; S $\rightarrow$ 2

PART – II: CHEMISTRY

SECTION - 1

One or More than One Option Correct Type

This section contains **6** questions. Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct option(s).

19. Which of the following statements is/are correct?

(A) The volume of the unit cell in HCP is $24\sqrt{2}r^3$

(B) The number of tetrahedral voids in an HCP unit cell not shared by the neighbouring unit cells is 8

(C) Height of HCP unit cell is $2r\sqrt{\frac{2}{3}}$ where 'r' is radius of atom

(D) The number of 5th nearest neighbour in BCC is 8 at a distance of $a\sqrt{3}$. (where 'a' is edge length of unit cell)

20. B_2O_n is oxidized to BO_3^- by $KMnO_4$ in acidic medium. If 5.36 m mol of B_2O_n required 64.4 ml of 0.1 M acidified $KMnO_4$ solution for complete oxidation, which of the following statement(s) is/are correct?

(A) The value of n = 2

(B) Empirical formula of the oxide is BO

(C) 1 mol of B_2O_n would required 1 mol of acidified $K_2Cr_2O_7$ solutions

(D) B can be a metal from second group of the periodic table

21. Select the incorrect statement(s) among the given statements

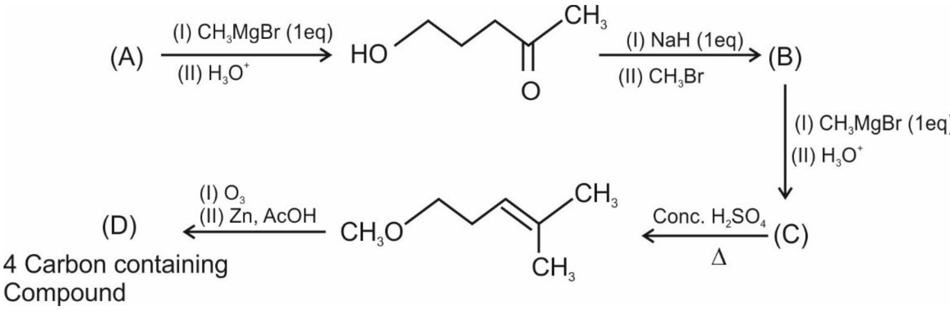
(A) Synergy bonding in metal carbonyl complexes will cause decrease in C–O bond length

(B) In $K[PtCl_3(\eta^2 - C_2H_4)]$, C – C bond length is less than C – C bond length of $CH_2 = CH_2$

(C) $UO_2^{+2} > UO_2^{+} > UF_4$ (order of oxidizing ability)

(D) Cis $[CrCl_2(en)_2]Cl$ has plane of symmetry

22. Consider the following sequence of reactions. Which of the given reaction(s) is/are true?



(A) Compound 'A' is cyclic ester with 6 membered Ring

(B) Compound 'B' will give Idoform test

(C) Compound 'C' is a secondary alcohol

(D) Compound 'D' will produce CO_2 with $NaHCO_3$

23. Some of the statements are given below. Which statement(s) is/are incorrect?

(A) In the titration of Boric acid against NaOH solution Phenolphthalein is suitable indicator

(B) The equilibrium constant of the reaction of a weak acid HA and strong base is 10^7. Then pH of 0.1M KA (potassium salt of HA) solution is 10

(C) The solubility of AgCl in 0.1 M NH_3 solution will be 0.04 M [Given K_{SP} of AgCl = 1×10^{-10}; K_f of $[Ag(NH_3)_2]^+$ = 1.6×10^9]

(D) Consider the following reaction at equilibrium

$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$. The molar mass of the equilibrium mixture was found to be 64. Then the degree of dissociation of SO_3 at equilibrium would be 0.50

24. Given the cell reaction

$$2Hg(l) + Cl_2(g) \longrightarrow Hg_2Cl_2(s)$$

The standard emf of the cell in volt E°_{cell} is related to temperature by the following equation and the substances involved are in their standard states.

$E^\circ_{cell} = 1.1 - 0.00034\,(T - 300)$

Where T is the temperature of the electrochemical cell

E°_{cell} at 300K = 1.10 V

The values of $\Delta H°$ (in KJ) and $\Delta G°$ (in KJ) for the reaction at 300 K are respectively ___

(A) –231.986 kJ, –212.3 kJ

(B) –231.986 kJ, –251672 kJ

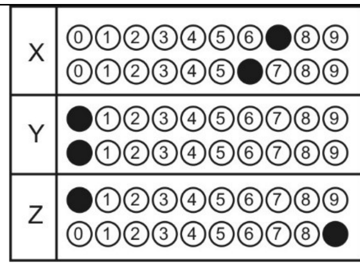
(C) –463.972 kJ, –483658 kJ

(D) –463.972 kJ, –444286 kJ

SECTION - 2

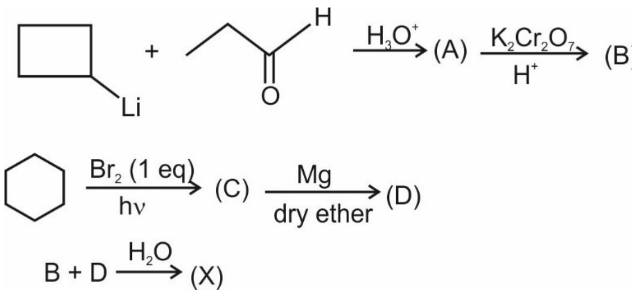
Integer Value Type

This section contains **8** questions. The answer to each of the question is a **Double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively



25. A 'V' ml of $1\%\left(\frac{w}{w}\right)$ NaCl solution of density 1.2 g/ml is required for complete coagulation of 500 ml of a gold sol. in two hours. The coagulation value of NaCl (in millimol/lit) was found to be 12. The value $\frac{100}{75}V$ is

26. When glucose reacts with HIO_4, it forms an acid and an aldehyde. The number of equivalents of $NaHCO_3$ needed to completely neutralise the acid formed from 1 mole of glucose is 'x'. When HIO_4 reacts with 1 mole of fructose the number of equivalents of $NaHCO_3$ needed to completely neutralise the acid formed is 'y'. If 't' and 'r' are the number of moles of HIO_4 used to react with 1 mole each of glucose and fructose respectively, then the value of x + y + t + r is

27. 

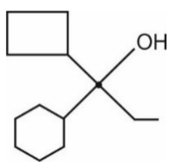
The number of statements is/are correct about the above sequence of reaction

(i) (A) & (B) are functional isomers

(ii) (B) will give positive iodoform test

(iii) Compound (D) is Grignard reagent

(iv) Compound (X) is



(v) Compound 'A' will undergo dehydration with Conc. H_2SO_4 through ring expansion to get major product

(vi) Reaction between B and D is Nucleophilic addition Reaction

(vii) Compound C will give turbidity immediately with Lucas reagent

(viii) B can also obtained by the Reaction of 'A' with Pyridinium dichromate (PDC)

28. Total number of isomers possible in a square planar complex of the type Mabcd (where a, b, c and d are different ambident ligands) is n, the value of $\frac{n}{6}$ is X. Total number of stereoisomers of 4-sec- butyl cyclohexanol is Y. The value of X + Y is

29. A system consisting of two moles of an ideal gas (not necessarily monoatomic) is subjected to the following sequence of steps

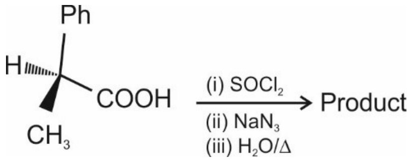
(a) It is heated at constant volume from 290 K to 390 K

(b) It is expanded freely into vacuum to double volume

(c) It is cooled reversibly at constant pressure at 290 K. The value of $\frac{|q|+|\omega|}{20R}$ is

(where R is gas constant, q is heat & ω is work done)

30. Consider the following reactions



How many of the following statement(s) is/are correct?

(a) It is an example of substitution reaction followed by Curtius reaction

(b) The product gives positive carbylamines test

(c) Product is optically active

(d) The absolute configuration of product is R

(e) Product is an aromatic primary amide

(f) Product can also be prepared by Hoffmann bromamide reaction method

(g) Product on further reaction with $NaNO_2$/HCl, produce 2° alcohol

(h) Product does not show geometrical isomerism

31. (i) The number of species among the following which do not exist at Room temperature is x

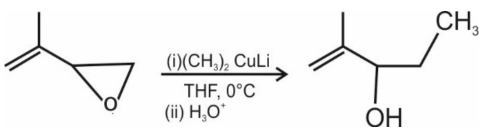
$LiHCO_3$(Solid), NH_3, SI_6, BiCl, $CsXeF_5$, PbI_2, KH_3 , NF_6^- , SH_2, BiF_4^- , $SiCl_6^{-2}$, ClF_7

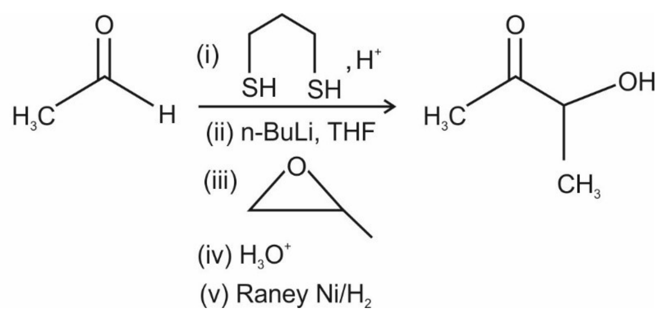
(ii) The number of species among the following having paramagnetic character and bond order ≥ 1 is y (Hypothetically)

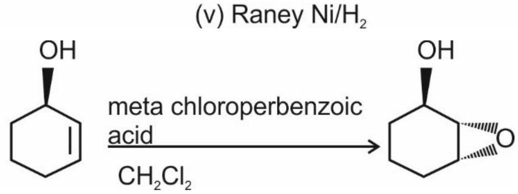
$He_2^+, B_2^-, CN^-, Li_2, C_2^-, BN, NO^+, N_2^{+2}, BO, BeO$

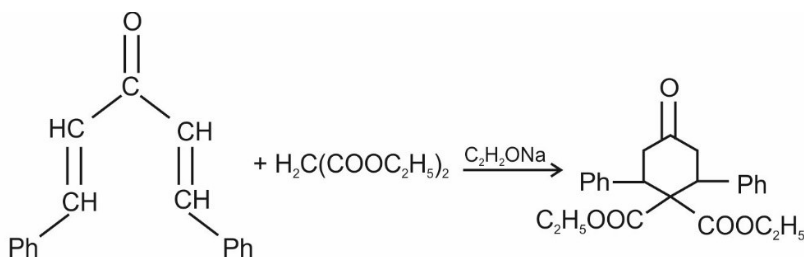
What is the value of x + y?

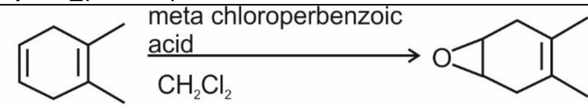
32. Consider the following reactions and find out how many of them give the incorrect product.

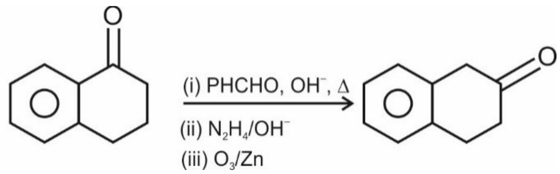
(i) 

(ii) 

(iii) 

(iv) 

(v) 

(vi) 

SECTION - 3

Matrix Match Type

This section contains Four **4** question. Each question has TWO (02) matching lists. LIST-I and LIST-II. Each question has Four options. **ONLY ONE** of these four options corresponds to the correct answer. For each question, choose the option corresponding to the correct answer.

33. Match the compounds given in List I with their properties given in List II.

List-I	**List-II**
(P) $(SiH_3)_3N$	(1) 3-centre-2-electron bond
(Q) BF_3	(2) sp^3 Hybridization
(R) SiO_2	(3) $p\pi - p\pi$ bond
(S) B_2H_6	(4) $p\pi - d\pi$ bond
	(5) sp^2 Hybridization

(A) P → 2, 3 ;Q → 1, 5 ; R → 3, 5 ; S → 2, 3
(B) P → 5 ;Q → 3, 5 ; R → 2 ; S → 1, 2
(C) P → 4, 5 ;Q → 3, 5 ; R → 2 ; S → 1, 2
(D) P → 1, 5 ;Q → 3 ; R → 2 ; S → 1

34. Match the Reagents in List I with the names of reactions in List II

List-I	**List-II**
(P) Aluminium tert butoxide	(1) Benzoin Condensation
(Q) Chromyl Chloride	(2) Oppenauer oxidation
(R) Hydrazine & potassium tertiary butoxide	(3) Etard Reaction
(S) Cyanide ion	(4) Wolf Kishner reduction

(A) P → 3 ;Q → 2 ; R → 1, 4 ; S → 1
(B) P → 2 ;Q → 3 ; R → 4 ; S → 1
(C) P → 2 ;Q → 4 ; R → 3 ; S → 1
(D) P → 2, 3 ;Q → 1, 3, 4 ; R → 3 ; S → 1

35. Match the Reactions given in List-I with the possible results and/or features given in List II

List-I	**List-II**
(P) $R-\overset{O}{\overset{\parallel}{C}}-OH \xrightarrow[Ag_2O/CH_3OH]{SOCl_2,\ CH_3N_2}$	(1) Product contains an ester functional group
(Q) $CH_3-CH_2-COOEt + (COOEt)_2 \xrightarrow{EtONa}$	(2) Free radical participates
(R) $R-\overset{O}{\overset{\parallel}{C}}-O-R' \xrightarrow[H_2O]{Na}$	(3) Ketene formed as an intermediate Product
(S) $CH_3-\overset{O}{\overset{\parallel}{C}}-CH_2-\overset{O}{\overset{\parallel}{C}}-O-C_2H_5 \xrightarrow[H_3O^+,\ \Delta]{dil\ KOH}$	(4) Product contains a keto functional group

(A) P → 1, 3; Q → 1, 4 ; R → 2, 4 ; S → 4
(B) P → 1, 3 ; Q → 4 ; R → 1, 4 ; S → 2
(C) P → 1, 2; Q → 1, 4 ; R → 4 ; S → 4
(D) P → 3 ; Q → 2 ; R → 4 ; S → 1

36. Match the defects given in List I and the statements given in List II and select the answer with the codes given below

List-I	List-II
(P) Metal excess defects	(1) Shown by ionic solid
(Q) Impurity defects	(2) density decreased
(R) Frenkel defects	(3) AgBr
(S) Schottky defects	(4) Shown by some of the alkali metal halides
	(5) Density remains constant
	(6) Shown by ZnO on Heating

(A) $P \to 2, 6$; $Q \to 1, 3, 4$; $R \to 2, 5$; $S \to 1$

(B) $P \to 6$; $Q \to 1, 4$; $R \to 1$; $S \to 1, 4, 5$

(C) $P \to 1, 2, 6$; $Q \to 3, 4$; $R \to 2, 5, 6$; $S \to 1, 4$

(D) $P \to 1, 2, 6$; $Q \to 1, 4$; $R \to 1, 3, 4, 5$; $S \to 1, 2, 3, 4$

PART – III: MATHEMATICS

SECTION - 1

One or More than One Option Correct Type

This section contains **6** questions. Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is(are) correct option(s).

37. If $\frac{\left(\sin^{-1}x\right)^2}{3}+\frac{\left(\cos^{-1}x\right)^2}{2}=\frac{\pi^2}{20}$, then

(A) $\left(\frac{\sin^{-1}x}{\cos^{-1}x}\right)^2=\frac{9}{4}$

(B) $\left(\frac{\sin^{-1}x}{\cos^{-1}x}\right)^2=\frac{3}{2}$

(C) $x=\frac{\sqrt{5}+1}{4}$

(D) $x=\frac{\sqrt{5}-1}{4}$

38. If $f(\theta)=|||3\sin\theta-\cos\theta|+2\sin\theta|+\sin\theta|$ where $\theta\in\left(\frac{3\pi}{2},2\pi\right)$ and $I_1=\int_{3\pi/2}^{2\pi}\ln\left(f(\theta)\right)d\theta$, $I_2=\int_{3\pi/2}^{2\pi}f\left(\pi f^2(\theta)\right)d\theta$, $I_3=\int_{3\pi/2}^{2\pi}f\left(2\pi f^2(\theta)\right)d\theta$, $I_4=\int_{3\pi/2}^{2\pi}f\left(\pi f(\theta)\right)d\theta$, then which of the following options is/are correct?

(A) $I_1 = -\pi\ln2$

(B) $I_2 = 0$

(C) $I_3 + I_4 = 0$

(D) $I_2 + I_3 + I_4 = 0$

39. Consider $A=\begin{vmatrix}1+(2020)^2 & (2020)\cos(\alpha-\beta) & (2020)\cos(\alpha-\gamma)\\ (2020)\cos(\alpha-\beta) & 1 & \cos(\beta-\gamma)\\ (2020)\cos(\alpha-\gamma) & \cos(\beta-\gamma) & 1\end{vmatrix}$ then,

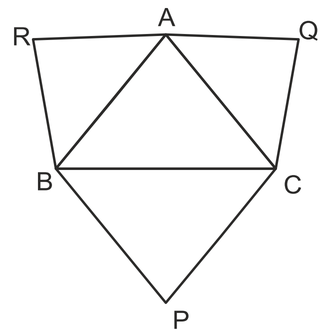
(A) A is independent of α

(B) If $\beta=\gamma+\alpha$ and α = 15° then A = $\frac{2-\sqrt{3}}{4}$

(C) If $\gamma=\beta+\alpha$, and α = 15° then $A=\frac{2-\sqrt{3}}{4}$

(D) If $\gamma=\beta+\alpha$ and α = 45° then $A=\frac{1}{2}$

40. Consider a scalene triangle *ABC*; $A(z_1)$, $B(z_2)$ and $C(z_3)$. With *BC*, *CA* and *AB* as sides, equilateral triangles PBC, QCA and ABR are drawn outwards as in figure such that $P(z_4)$, $Q(z_5)$ and $R(z_6)$. Let $X((z_0)_1)$, $Y((z_0)_2)$, and $Z((z_0)_3)$ be the centroids of triangle PBC, QCA and ABR respectively. Identify the correct statements.



(A) Centroid of ΔABC co-incides with centroid of ΔPQR

(B) Centroid of ΔXYZ coincides with centroid of ΔPQR

(C) $|z_1 + z_2 + z_3| = |z_4 + z_5 + z_6|$

(D) $|(z_0)_1 + (z_0)_2 + (z_0)_3| = |z_1 + z_2 + z_3|$

41. Consider a tetrahedron ABCD having ΔABC as it's base such that $\angle ACB$ = 30°, and $\sqrt{2}(AC + BC) + AD = 9\sqrt{2}$. Considering the volume of the tetrahedron as $\frac{9}{2\sqrt{2}}$ units, identify the correct statements,

(A) Height of the tetrahedron = AD

(B) *AC* = *BC*

(C) $\frac{AD}{CD} = \frac{\sqrt{2}}{\sqrt{3}}$

(D) $AB = 3\sqrt{2 - \sqrt{3}}$

42. If $f(x) = \int_1^x e^x \left(\ln(4x-3) - \frac{12}{x}\left(\frac{x-1}{4x-3}\right) - 4\ln x \right)$ then

(A) $f'(3) < -2e^3 \ln 3$

(B) $f(3) = -2e^3 \ln 3$

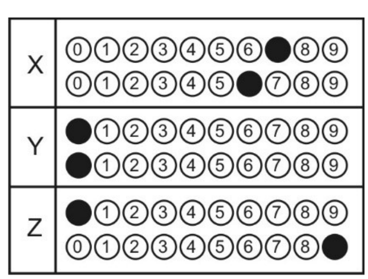
(C) $\lim_{x \to 1} \frac{f(x)}{(x-1)^2} = 6e$

(D) $\lim_{x \to 1^+} \frac{f(x)}{(x-1)^2} = -6e$

SECTION - 2

Integer Value Type

This section contains **8** questions. The answer to each of the question is a **Double-digit integer,** ranging from 00 to 99. The answer will have to be appropriately bubbled in the OMR as per the instructions as follows. **Examples-** If the correct answer to question numbers X, Y and Z (say) are 76, 0 and 9 respectively, then mark 76, 00 and 09 in OMR respectively



43. Each of 2020 boxes in a row contains one blue ball and for $1 \le k \le 2020$, the box in the k^{th} position also contains k red balls. A man begins at the first box and successively drawn a single ball at random from each box in order. He stops when he first draws a blue ball. Let P(n) be the probability that he stops after drawing exactly n balls. The least values of n for which $P(n) < \frac{1}{2020}$ is

44. The lengths of tangents drawn from the vertices A, B & C to the incircle of ΔABC are 6, 5, 4 units respectively. If the lengths of parts of tangents with in the triangle which are drawn parallel to the sides BC, CA & AB of the triangle to incircle are α, β & γ respectively then $\frac{15}{4}(\alpha+\beta+\gamma)$ is

45. If $k \in z^+$, then the minimum positive integral value of k for which the equation $e^{3x} = kx^2$ has exactly three distinct real solutions is

46. Consider a sequence of real numbers a_n defined by $a_1 = 1$, $a_2 = 1$ and $a_{n+1} = \frac{a_n}{1-n(a_n)}$ for $n > 1$, $n \in N$. If $S = \sum_{m=1}^{1010} \frac{1}{2m-1}\left(\frac{1}{(a_{2m-1})^2} - \frac{1}{(a_{2m})^2}\right)$, then $\left[\frac{-3S}{(2018)^2 \times 1009}\right]$ (where [ ] is greatest integer function) is equal to

47. If $a + b + c = -106$ and the roots α_1, α_2 and α_3 of $x^3 + ax^2 + bx + c = 0$ are integers and greater than 2 then $(\alpha_1 + \alpha_2 + \alpha_3)$ is equal to

48. Consider the triangles ABC and A'B'C' with A(1, 1), B(2, 3) and C(6, 5); A'(12, 8), B'(1, 1) and C'(9, – 3). P,Q,R lies on BC, CA and AB respectively such that $\frac{AR}{RB} = \frac{AQ}{QC} = \frac{1}{2}$ and P', Q', R' lies on $B'C', C'A'$ and $A'B'$ such that $\frac{A'R'}{R'B'} = \frac{2}{3}, \frac{AQ'}{Q'C'} = \frac{1}{3}$. If AP and $A'P'$ are concurrent with BQ, CR and $B'Q'$, $C'R'$ respectively and when extended touches the circle of radius r. Then r^2 equals

49. If the real root of $(2019)\sqrt{x+1} + \sqrt{2-2019x} = \sqrt{(2020)(2021)}$ is a, then $\left[\frac{2021}{2019} + (2020)a\right]$ equals. (Where [ ] is greatest integer function)

50. Tangents are drawn to the parabola $y^2 = 4x$ at P(t_1 = 1), Q(t_2 = – 2) and R(t_3 = 3) which meets at A, B, C. If the perpendicular bisector of the line joining the orthocentre H of ΔABC and focus S of $y^2 = 4x$ meets x-axis at K, and area of ΔSKH is α, then number of factors of $\sum_{n=1}^{\infty}\left[\frac{2020}{\alpha^n}\right]$ is (Where [ ] is greatest integer function)

SECTION - 3

Matrix Match Type

This section contains Four **4** question. Each question has TWO (02) matching lists. LIST-I and LIST-II. Each question has Four options. **ONLY ONE** of these four options corresponds to the correct answer. For each question, choose the option corresponding to the correct answer.

51. Match the following:

List-I	**List-II**
(P) $S = \lim_{n\to\infty} \sum_{r=1}^{n} \frac{r^2}{n}\left(\frac{\left(\sum_{k=1}^{n} k^2\right) - \frac{(2n^2-5n-6)(n+1)}{6}}{\sum_{k=1}^{n} K^3}\right)$ then {4S} (Where { } is fractional part) is	(1) 3

(Q) If $L = \lim\limits_{x\to 0} \dfrac{2\tan^{-1}\left(\operatorname{cosec}\left(\tan^{-1}x\right) - \tan\left(\cot^{-1}x\right)\right)}{3\sin 2x + 2\tan^{-1}3x}$ then {4L} is (2) 1

(where { } is fractional part)

(R) Number of values of x satisfying $x^2 - 4x + 2[x] + [-x] + 4 = 0$ (3) 0

(where [ ] is greatest integer value) is

(S) Number of integral multiples of 9 satisfying $4\sqrt{\log_3 x - 2} + \log_{1/3} x^5 + 11 \geq 0$ is (4) $\dfrac{1}{3}$

(A) P $\to$ 3 ;Q $\to$ 4 ; R $\to$ 2 ; S $\to$ 1

(B) P $\to$ 4 ;Q $\to$ 3 ; R $\to$ 1 ; S $\to$ 2

(C) P $\to$ 4 ;Q $\to$ 3 ; R $\to$ 2 ; S $\to$ 1

(D) P $\to$ 4 ;Q $\to$ 4 ; R $\to$ 3 ; S $\to$ 1

52. Let the line $\dfrac{x-2}{3} = \dfrac{y-1}{-5} = \dfrac{z+2}{2}$ lie in the plane $x + 3y - \alpha z + \beta = 0$, then

List-I	**List-II**
(P) The number of distinct terms in $(x+y+z)^\beta$ is equal to	(1) $^{14}C_3$
(Q) The value of $\sum\limits_{i=0}^{n-2} {}^{n-i}C_2$, where $n = \beta - \alpha$ is equal to	(2) 27
(R) The number of integral solutions of $x_1x_2x_3 = -\alpha\beta$ is	(3) 46
(S) The distance of the plane $x + 3y - \alpha z + \beta = 0$ from (1,1,1) is $\dfrac{17}{\sqrt{k}}$ then k is	(4) 108
	(5) $^{9}C_2$

(A) P $\to$ 1; Q $\to$ 5; R $\to$ 2; S $\to$ 3

(B) P $\to$ 5; Q $\to$ 1; R $\to$ 4; S $\to$ 3

(C) P $\to$ 5; Q $\to$ 1; R $\to$ 2; S $\to$ 3

(D) P $\to$ 5; Q $\to$ 2; R $\to$ 1; S $\to$ 3

53. Match the following

List-I	**List-II**
(P) Number of ways in which the word “CORONA” can be partitioned in two or more parts so that each part contains at least one vowel is	(1) 6
(Q) If A is a square matrix of order n such that $\lvert A\rvert = \sqrt{3}$ and ||AdjA| adj(adjA)| = 27^{13} then the value of n is	(2) 7
(R) Number of solution (R) of $5\cos 4x + 14\cos 2x + 10 = 32(\cos x)^6$ in $[0, \pi]$ is	(3) 8
(S) If $(a-2)^2 + (a-b)^2 + b^2 = \dfrac{4}{3}$, $\left(\dfrac{1}{2} < b < a < \dfrac{3}{2}\right)$ then $3(a+b)$ is	(4) 9

(A) P $\to$ 1; Q $\to$ 2 ; R $\to$ 4 ; S $\to$ 3

(B) P $\to$ 3 ; Q $\to$ 2 ; R $\to$ 1 ; S $\to$ 1

(C) P $\to$ 4; Q $\to$ 3 ; R $\to$ 1 ; S $\to$ 2

(D) P $\to$ 1 ; Q $\to$ 4 ; R $\to$ 3 ; S $\to$ 1

54. The complex numbers Z_1, Z_2, Z_3 .....Z_n represent the vertices of regular polygon of n sides inscribed in a circle of unit radius and $\bar{Z}_3 + \bar{Z}_n = A\bar{Z}_1 + B\bar{Z}_2$ (where [.] represents greatest integer function)

List-I	**List-II**
(P) for n=4, [|A|] is equal to	(1) 7
(Q) Re(A) is equal to	(2) 4
(R) The number of integral values in the range of AB is	(3) 1
(S) for n=12 the value of [5|A|] is equal to	(4) 2

(A) $P \rightarrow 4$; $Q \rightarrow 3$; $R \rightarrow 1$; $S \rightarrow 2$

(B) $P \rightarrow 4$; $Q \rightarrow 2$; $R \rightarrow 3$; $S \rightarrow 1$

(C) $P \rightarrow 4$; $Q \rightarrow 3$; $R \rightarrow 2$; $S \rightarrow 1$

(D) $P \rightarrow 3$; $Q \rightarrow 4$; $R \rightarrow 2$; $S \rightarrow 1$

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